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Safety Analysis of the National Ignition Facility*

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The National Ignition Facility (NIF) is a proposed U.S. Department of Energy inertial confinement laser fusion facility. The candidate sites for locating the NIF are: Los Alamos National Laboratory, Lawrence Livermore National Laboratory (preferred site), Sandia National Laboratory, and the Nevada Test Site. The NIF will operate by focusing 192 laser beams onto a tiny deuterium-tritium or deuterium-deuterium target located at the center of a spherical target chamber. The NIF mission is to achieve inertial confinement fusion (ICF) ignition, access physical conditions in matter of interest to nuclear weapons physics, provide an above ground simulation capability for nuclear weapons effects testing, and contribute to the development of inertial fusion for electrical power production.

The NIF has been classified as a radiological, low hazard facility on the basis of a preliminary hazards analysis and according to the DOE method for facility classification. This requires that a safety analysis be prepared under DOE Order 5481.1B, Safety Analysis and Review System. A Preliminary Safety Analysis is currently underway, and the PSAR will be completed later in 1996.

The safety analysis process began with identification of hazards. These primarily consist of the laser, tritium handling, prompt radiation generated during shots, and neutron activated material, including structures in the immediate area and air in the target chamber room. The target chamber is housed in a cylindrical, reinforced-concrete building. The radiation shield (Al target chamber, concrete shield around the chamber, and concrete walls and roof of the target chamber room) will reduce radiation levels outside the facility such that site boundary exposures from prompt radiation (approximately 340 m away at the preferred site) will be less than 0.2 mrem/yr for the expected shot sequence. Airborne releases of activated gases and tritium could add about 0.1 mrem/yr to this at the site boundary. Routine maintenance occupational exposures will be controlled by delay time before access, shielding, including temporary shielding as needed, work time constraints, remote operations, personal protective equipment, training, and proper procedures. The NIF utilizes a very powerful laser with an associated large electrical energy storage and discharge system which present significant electrical and optical hazards. Controls to prevent accidents from laser operation include: physical barriers, interlocks, protective eye equipment, visual and audible alarms, video surveillance, personnel accountability, training, and specific procedures.

Accidents associated with the operation of the NIF were also identified as part of the safety analysis process. Consistent with DOE's graded approach to safety analysis, where the level of effort associated with the safety analysis should be graded with the level of hazard, the NIF safety analyses have been deterministic rather than probabilistic assessments. The consequences of a few bounding accidents were analyzed quantitatively to define the operating envelope for NIF. Event frequencies were evaluated qualitatively and were primarily judgment based. The maximum consequence to the public from any postulated radiological accident is several hundred mrem, and this is associated with an extremely unlikely event.

Chemical hazards associated with the NIF were also evaluated. These include solvents used for cleaning, ablated material formed in the target chamber, and materials such as mercury used in electrical equipment. Routine emissions of any hazardous materials are expected to be very low. Any accidental releases result in negligible offsite consequences.

In addition to identifying hazards and evaluating impacts, the safety analysis serves the purpose of helping identify safer design alternatives and controls for hazards. In this way, the risks associated with operation of the NIF will be minimized.

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